

WHAT IS CLAIMED IS:

1. A position detecting method for detecting positional information of a mark formed on a substance, comprising:

5 picking-up at least one image of said mark under an image pick-up condition including a plurality of defocus states;

 obtaining a relationship between picked-up image state of said mark and said defocus amount, based on image pick-up results in said image pick-up condition; and

10 detecting said positional information of said mark based on said relationship.

2. The position detecting method according to claim 1, wherein

15 in said picking-up the image, said image of said mark is picked-up on an image pick-up plane which tilts against an imaging plane on which said image of said mark is formed.

3. The position detecting method according to claim 1, wherein

20 in said obtaining said relationship, a positional information of said characterized point at a focus state is estimated by using said image picked-up results at said plurality of said defocus states.

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4. The position detecting method according to claim 3, wherein

 in said obtaining said relationship, a positional

information of said characterized point at a focus state is estimated, considering a respective contrast of image pick-up results at said plurality of said defocus states.

5 5. The position detecting method according to claim 3, wherein

said defocus states include either plus defocus states or minus defocus state, and

10 a position of said characterized point at said focus state is estimated by an extrapolation method using positions of said characterized point obtained from said image pick-up results at said defocus states.

15 6. The position detecting method according to claim 3, wherein

a plurality of said defocus states include a plus defocus state and a minus defocus state, and

20 a position of said characterized point at said focus state is estimated by an interpolation method using positions of said characterized point obtained from said image pick-up results at said defocus states.

25 7. The position detecting method according to claim 1, wherein said image pick-up condition further comprises a focus state, and said obtaining relationship comprises:

estimating a positional information of said characterized point at said focus state using said picked-up image at said plurality of defocus states; and further

estimating said positional information of said characterized point at said focus state using said picked-up image at said focus state.

5 8. The position detecting method according to claim 7, wherein

in said detecting positional information, said positional information is estimated, considering a respective contrast of image pick-up results at said plurality of defocus states and said focus state.

9. The position detecting method according to claim 7, wherein

said defocus states include either plus defocus states or minus defocus states, and

a position of said characterized point at said focus state is estimated by an extrapolation method using positions of said characterized point obtained from results at said defocus states.

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10. The position detecting method according to claim 7, wherein

said defocus states include a plus defocus state and a minus defocus state, and

25 a position of said characterized point mark at said focus state is estimated by an interpolation method using positions of said characterized point obtained from said image pick-up results at said defocus states.

11. The position detecting apparatus which detects a positional information of a mark formed on a substance, comprising

5 an imaging optical system, which forms an image of the mark;

 an image pick-up unit which picks-up the image of the mark formed by the imaging optical system; and

 a processing unit, which is electrically connected to
10 said image pick-up unit, and which obtains said relationship between picked-up image state of the mark and defocus amount based on the image pick-up results by using the image pick-up unit under an image pick-up condition including a plurality of defocus states.

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12. The position detecting apparatus according to claim 11, wherein

 a surface condition of said mark is changing along a predetermined direction, and

20 said image pick-up unit comprises a image pick-up plane which is rotated around a direction in an imaging plane on which said image is formed by said imaging optical system corresponding to said predetermined direction.

25 13. The position detecting apparatus according to claim 12, wherein

 said image pick-up plane intersects said imaging plane.

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14. The position detecting apparatus according to claim 11, further comprising:

a tilt adjustment mechanism which adjusts rotation amount of an image pick-up plane of said image pick-up unit around a direction in an imaging plane on which said image is formed by said imaging optical system corresponding to said predetermined direction.

15 10 15. The position detecting apparatus according to claim 11, further comprising:

a moving mechanism which relatively moves a imaging plane, on which said image of said mark is formed by said imaging optical system, and said image pick-up plane of said image pick-up unit along an optical axis direction of the imaging optical system.

16. An exposure method for transferring a predetermined pattern to a divided area on a substrate, comprising:

20 detecting a positional information of marks formed on the substrate for a position detection by using said method according to claim 1, obtaining a predetermined number of parameter for a position calculation of said divided area, and calculating an arrangement information of the divided area on the substrate; and

25 transferring the pattern to the divided area while controlling a position of said substrate, based on the arrangement information of said divided area.

17. An exposure apparatus which transfers a predetermined pattern to a divided area on a substrate, comprising:

5 a stage unit which moves said substrate along a moving plane; and

a position detecting apparatus according to claim 11, which detects positional information of said marks on the substrate mounted on the stage unit.

10 18. A making method of an exposure apparatus for transferring a predetermined pattern to a divided area on a substrate, comprising:

providing a stage unit which moves the substrate along a moving plane; and

15 providing a position detecting unit, which detects a positional information of a mark on said substrate, which is mounted on the stage unit, wherein the position detecting unit comprises:

20 an imaging optical system which forms an image of the mark, formed on the substrate;

an image pick-up unit which picks-up a image formed by said imaging optical system; and

25 a processing unit which obtains a relationship between picked-up image state of the respective mark and defocus amount based image pick-up results by using the image pick-up unit under an image pick-up condition including a plurality of defocus states, and detects positional information of the marks based on the relationship.

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19. A computer readable recording medium containing data for a control program to be executed by a position detecting unit to detect a mark position formed on a substrate, wherein

5 the control program comprises:

allowing to pick-up at least one image of said mark under an image pick-up condition including a plurality of defocus states;

10 allowing to obtain a relationship between the picked-up image state of said mark and defocus amount; and

allowing to detect a positional information of said mark, based on the relationship.

15 20. A device manufacturing method including a lithographic process, wherein

an exposure is preformed by using said method according to claim 18 in said lithographic process.

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